DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to record and playback of information, and the information storage method for eliminating by the exposure of an energy beam, especially relates to the suitable information storage method for an optical disc.
[0002]
[Description of the Prior Art]In recent years, the demand to an optical disc is increasing with diversification of information, and large-scale-izing. There are a playback exclusive disc, a record reproduction optical disc which can do additional recording, and a rewritable optical disc which can perform rewriting of information in this optical disc. When the user itself uses the record reproduction optical disc and rewritable optical disc which can record information among these, a long lightwave pulse may be irradiated by the track direction of high power depending on the contents of information.

[0003]Optical instead of a long lightwave pulse Society OBU United States, Optical Data Storage, Technical Digest Series From the 50th volume [10th] (1987) page to the 53rd page (Technical Digest Optical Society of America, Optical Data Storage) The method of irradiating with a pulse with same power, pulse width, and cycle continuously predetermined time is known as indicated to Sevies and Vol.10 (1987) pp.50-53.
[0004]
[Problem(s) to be Solved by the Invention]When it is long to a track direction and glares by the laser beam of high power using the above-mentioned conventional technology, by heat conduction, temperature becomes high, and the width of the disk radial of the field recorded or eliminated becomes large, and it goes as the place irradiated behind. That is, the shape of the formed record or an erasure part turns into tear-drop. Since a regenerative signal waveform has distortion when a signal is reproduced from a such-shaped portion, in the case of a pit edge detection system, there are problems -- S/N does not worsen or the regenerative signal which was surely equivalent to the record signal is not acquired.

[0005]Since it is going to eliminate or record this tear-drop record or erasure part, for example, there is a portion to which the width of the radial direction of a recording point is large rather than eliminable width in elimination, it will disappear and the remainder will arise. Since there is a portion into which the temperature of a film surface rises more than needed, a ground film etc. may change and a noise may increase.

[0006]There was a method variously proposed as these solution, and all need analog processing in signal processing, and it became complicated also from a viewpoint of signal processing also from a viewpoint of digital circuit composition.

[0007]When the pulsed light exposure of long high power is performed to a track direction, the purpose of this invention does not serve as tear-drop, but is in making the recording part or erasure part of an ellipse which was ready in the track direction form easily.

[0008]

[Means for Solving the Problem]The above-mentioned purpose divides a pulse of the longest pulse width into two or more two or more trains of impulses at least, It is attained by recording changing at least three or more kinds of exposure energy level set up beforehand similarly, if the rear of the original pulse is made into a waveform that average irradiation energy becomes small. Here, average irradiation energy says a thing of average energy irradiated on a film surface in within a time [each], when a lightwave pulse is divided at equal intervals with arbitrary time width.

[0009]For this reason, in a way claim 1 of this invention performs record or rewriting to an optical disc which can record information by the exposure of a laser beam, Laser light power with which the above-mentioned optical disc is irradiated shall be irradiated on three levels, the at least l-th, the 2nd, and the 3rd, and the 2nd level, Rather than the 1st level, consider it as a high power level and the 3rd level, When considering it as a power level higher than the 2nd level and forming a recording point in the above-mentioned optical disc at the time of record of information, or rewriting, It irradiates with a laser beam beforehand maintained at power of the 2nd level of the above at least, Next, shall irradiate with a laser light pulse which has the power which reaches the 3rd level of the above, and has predetermined time width, and the above-mentioned recording point shall be formed. A pulse which has the longest pulse width at least among the above-mentioned laser light pulses was divided into a train of impulses which consists of two or more pulses, and the purpose is attained by making pulse width of a leading pulse of this train of impulses larger than pulse width of the 2nd pulse following a leading pulse.

[0010]In a way an exposure of a laser beam performs record or rewriting to an optical disc which can record information in claim 2, Having arranged a train of impulses divided also to a space part between adjoining recording points, average power of a split pulse sequence of this space part has attained the purpose by using a train of impulses set up become power lower than average power of the above-mentioned record point.

[0011]

[Embodiment of the Invention]Hereafter, an example explains this invention in detail.

[0012]Drawing 1 (1) - (5) is a wave form chart showing an example of the advanced technology which

will be the requisite for this invention. Drawing 2 (1) - (5) is an explanatory view of the conventional record method shown for comparison. Both perform record, reproduction, and elimination by two beams.

[0013]First, the record method in the advanced technology is explained using drawing 2 (1) - (5). Here, the case where record, playback, and elimination are performed is stated to the Sn-Te-Se system record film which is phase-change optical disk record film. The semiconductor laser (wavelength of 830 nm) was used on the record film which is a crystallized state, and it recorded by the recording pulse train as shown in drawing 2 (1). Here, as for W, recordable power and R show read-out power. In this case, recording pulse C used one 3 times the pulse width of recording pulse A. The time shift of the average irradiation energy at this time was shown in drawing 2 (2). In this example, in order to make it intelligible, the average irradiation energy within the time which divided recording pulse C into three equally, i.e., the same time as recording-pulse-width A, is shown, respectively. When it records by such a recording pulse train, the temperature of the portion which serves as an elevated temperature most among optical irradiation areas shows a temporal change like drawing 2 (3). And at the place where sample temperature exceeded the melting point, fusion will take place and the place will be in an amorphous state by quenching after that. And although a circular amorphous portion (recording point) can be formed in recording pulse A, While becoming an ellipse in recording pulse C in a track direction, in the portion irradiated later for heat conduction as shown in the slash figure on the right-hand side of drawing 2 (4), an amorphous portion spreads radially (this shape is called tear-drop). When such a recording point was reproduced by the edge detection method, like drawing 2 (5), rather than the regenerative signal corresponding to recorded information, timing shifted for a while and the error arose. big [if power performs elimination by crystallization by a fixed laser beam, at the point recorded by recording pulse A, it is certainly eliminable, but] at the tear-drop recording point recorded by recording pulse C -- it disappeared and the remainder arose. In the portion with which the long recording pulse was irradiated, change is produced in a ground film or a protective film with heat, and it caused a noise and reduced S/N. Thus, there was a problem in forming a long recording point by the conventional method.

[0014]Drawing 1 (1) - (5) shows the example of the advanced technology known as a method for solving the problem of the above-mentioned conventional method. The recording pulse train used for the example of this advanced technology was carried out like drawing 1 (1). This improves the pulse shape of drawing 2 (1). Although the total recording pulse width of recording pulse B is the same as recording pulse C of drawing 2 (1), in the example of this advanced technology, recording pulse B is divided for the purpose of preventing formation of a tear-drop recording point so that it may become small gradually, as average irradiation energy showed drawing 1 (2). Here, it is the split method which fixed time (interval of the trailing edge of a precedence pulse, and the front tip of a following pulse) to the power change of a recording pulse. When it records by such a recording pulse train, the temporal change of the temperature shown in drawing 1 (3) is shown. As a result, the recording point as shown in drawing 1 (4) has been formed. That is, if not a tear-drop recording point [as / in the conventional method shown in drawing 2 (4)] but the recording point of an ellipse that the form was ready in the

track direction is acquired and this is reproduced, the regenerative signal corresponding to a recording point is acquired like drawing 1 (5). moreover -- if these recording points are eliminated -- almost -- remaining unmelted -- it will not be generated but good record/erasing quality will be acquired.

[0015]If it is considered as the method of dividing a long recording pulse, some are considered, but in order to prevent the breadth of heat in all the cases, it is necessary to make average irradiation energy small gradually. This average irradiation energy is the average value within arbitrary unit time, and since the time width to average differs in thermal conductivity etc. by a film sample, it must be changed suitably each time. That is, although it was considered as trisection in drawing 1 (2), it is good also considering this as four division into equal parts. However, it must be made for the average energy irradiated in unit time also in this case to have to become small gradually. On the other hand, if only it is necessary to divide no recording pulses in the above-mentioned technique and divides the at least longest recording pulse, What is necessary is just to divide a next recording pulse if needed, and the number of the stages of changing the number of partitions and power may have so little division at other recording pulses that it is few and pulse width is shorter than the longest recording pulse. If the method of dividing a lightwave pulse is a split method with which the average irradiation energy within the predetermined time of an optical pulse train will become small later, here, What kind of methods, such as the method of fixing record power, changing recording pulse width or a pulse interval gradually, and going, a method of fixing recording pulse width and changing record power, or a method of changing record power and recording pulse width, may be used. What is necessary is here, just to use digital one, a signal, a generator, etc. to change pulse width and a pulse interval.

[0016]drawing 3 (a) - (e) and drawing 4 (a) - (e) -- the above -- the example of division of a long recording pulse is shown. The pulse is divided so that the average irradiation energy at the time of carrying out trisection of the recording pulse with the same long width as drawing 2 (1) in all the examples of drawing 3 and drawing 4 may become small gradually. In order to make it intelligible, pulse width of the first divided recording pulse and pulse width of the recording pulse (for example, recording pulse A) which is not divided were made the same, but it is not necessary to necessarily make it the same.

[0017]Drawing 3 (a) fixes the record power and pulse width of each pulse after the second divided recording pulse, and shows an example at the time of changing the interval of a pulse.

[0018]Drawing 3 (b) fixes record power of each divided pulse, and shows an example at the time of changing pulse width and a pulse interval gradually.

[0019]Drawing 3 (c) fixes the pulse width of each pulse after the second divided pulse, and the interval of a pulse, and it shows an example at the time of making record power small one by one.

[0020]Drawing 3 (d) fixes only the pulse interval of each divided pulse, and shows an example at the time of changing record power and pulse width.

[0021]Drawing 3 (e) shows an example at the time of changing the record power of each divided pulse, pulse width, and all the pulse intervals.

[0022]Drawing 4 (a) - (d) shows the example at the time of changing the ******** power of the divided

pulse. That is, although all the divided pulses are once lowered to the read-out power R in drawing 3 (a) - (d), in drawing 4 (a) - (d), it read, and it stops by power higher than power, or even zero level has lowered. these -- drawing 3 (a) - (d) -- the same -- record power and pulse width -- pulse interval change is carried out and the split method of various patterns can be considered like a graphic display. Despite a join office, if only average irradiation energy becomes small gradually, the split method of a recording pulse may be done what.

[0023]By the waveform of drawing 1 (1), drawing 3 (a), and (b), since the amplitude of power change is constant, there is the strong point in which formation of a pulse shape is easy among each pulse shape in the advanced technology expressed above. Since one power level of the waveform of drawing 3 (c), (d), (e), drawing 4 (a), (b), and (c) is constant, it is poured for the above-mentioned waveform and is easy to form.

[0024]As stated above, about plastic surgery of the recording point in the case of performing thermal recording of long-pulses width, the advanced technology has been proposed variously, but. Since analog characteristics are given and a circuit design or adjustment is performed into a digital circuit, design adjustment is complicated and it cannot be said that it is enough not necessarily practically. An embodiment explains this invention below.

[0025]

[Embodiment 1] Drawing 5 (a) and (b) shows the record erasing method in the conventional example (a) and embodiment of the invention as a comparative example at the time of using the sample which can perform record, reproduction, and elimination with one beam. It is here, and W shows a record power level, E shows an elimination power level, and R shows a read-out power level.

[0026]If record and elimination are performed by a conventional method like drawing 5 (a), a tear-drop recording point will be too formed in the portion which can irradiate with power with a high laser beam for a long time. What is necessary is just to divide a long recording pulse into some pulses like drawing 5 (a), in order to prevent this. Drawing 5 (b) is what showed the example, and shows the case where the interval of a pulse is fixed. In addition, various split methods can be considered like drawing 3, drawing 4, etc.

[0027]On the other hand, by the waveform of drawing 5 (a), power falls from a high level, in the portion kept long to a middle power level, since the temperature of irradiation portions falls gradually and a crystallization rate is changed, the portion which suited the amorphous state before the exposure may not be crystallized enough, but it may disappear, and the remainder may be produced. In order to prevent this, as shown in drawing 5 (b), it is as good as the rear of the portion of a middle power level to make it average irradiation energy become high.

[0028]Although the direction of change of energy is reverse, a pulse shape which was described by drawing 5 (1) can be used. Namely, what is necessary is to reverse a time-axis and just to arrange the pulse of the field corresponding to B of drawing 1 (1) of drawing 1, drawing 3, and drawing 4 in on a middle power level. The waveform of drawing 5 (b) makes a time-axis reverse for the pulse after the 2nd of the area Bs of drawing 3 (a) on a middle power level, and is put in order.

[0029]It is preferred to increase the number of partitions or the step number of a power change as the

portion which the exposure of a middle power level or a high power level follows for a long time.
[0030]
[Embodiment 2] If a recording pulse train like drawing 6 (a) is used when recording on the sample whose crystallization rate is extremely quick (amorphous-izing), reflected light intensity will become like drawing 6 (b), and the regenerative waveform corresponding to a recording pulse will not be obtained. That is, only the ****** place of a recording pulse can perform amorphous-ization. Henceforth [starting of a pulse], even if it compares and exceeds the melting point, since the crystallization rate is quick, when getting cold, it will crystallize, but since laser radiation stops at a ****** part suddenly, it quenches, and only this portion is made amorphous. However, also in this case, in a ****** part, it becomes a big recording point by the breadth of heat, and it will disappear at the time of elimination and the remainder will become large. Then, in order to solve these problems, a recording pulse train like drawing 6 (c) was used. The foundations of a view are the same as above-mentioned drawing 5 (1) etc., and a long recording pulse is divided so that average irradiation energy may become small gradually. That is, in order that amorphous-ization by quenching of the portion (it is called a space below) between the adjoining recording points (mark) may solve the problem which carries out localization, this space part is also irradiated with the light energy of a low. For this reason, when laser power is a portion which crystallizes the portion of an intermediate level, reflected light intensity is high a little rather than the nonreflective level like drawing 6 (d).
[0031]Formation of the field faithful to the signal which should be recorded by recording by on the other hand record power continuing and irradiating with the recording pulse whose pulse width it is large and is small in the portion made to make it amorphous was attained. As a result, a good regenerative waveform like drawing 6 (d) was obtained. The recording pulse train described in the above-mentioned example is so good to lessen the number of division, and the stage of change of power that the width of the portion which profits are large and an almost fixed power level follows especially to execution of record, reproduction, and elimination in any [of one beam or two beams] case is short.
[0032]
[Effect of the Invention]According to this invention, since the record pit of the shape of an ellipse which did not turn into tear-drop but was ready in the track direction can be made to form also when forming a long record pit in a track direction, it remains unmelted at the time of the error rate of a regenerative signal, and elimination, and there is an effect which lessens the increase in a noise by modification, etc.
[0033]In this invention, when using a phase change recording medium, an effect is the largest, but also when using other optical recording media, such as an optical magnetic recording medium and a recording medium by hole formation, an effect is large. In order to control the breadth of the heat to the radial direction of a disk, changing between the levels which divided the lightwave pulse long to a track direction into some pulses and with which the exposure power level was also set up beforehand, The record or the elimination field formed does not serve as tear-drop, but the shape of an ellipse to which the form was ready in the track direction can be acquired. That is, it remains

unmelted at the time of the error rate of a regenerative signal, and elimination, and problems, such as an increase in a noise by modification, can be solved easily.

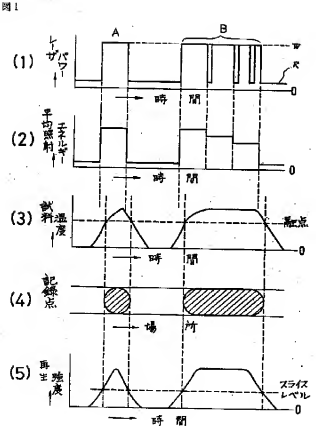
[0034]If postscript die materials, rewritable phase change materials, optical magnetic adjusters, etc., such as hole formation, are used as a record film material, the same result is obtained and an effect is large, but it is effective even if it uses this invention, when using other recording materials. In the case of a phase change material, the effect of this invention is the largest.

[Translation done.]

DRAWINGS

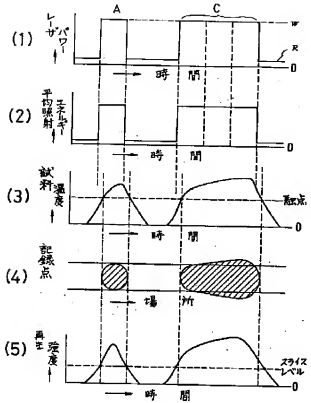
[Drawing 1]

図1



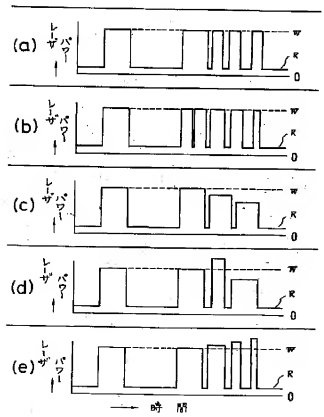
[Drawing 2]

図2



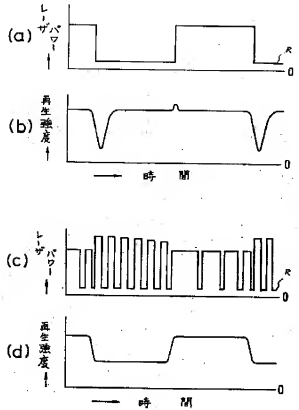
[Drawing 3]

図3



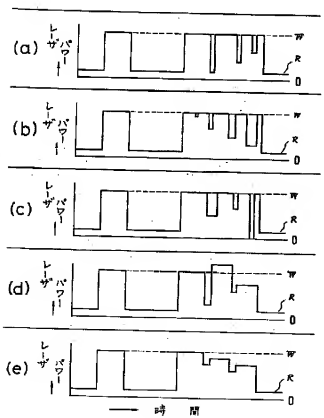
[Drawing 6]

図6

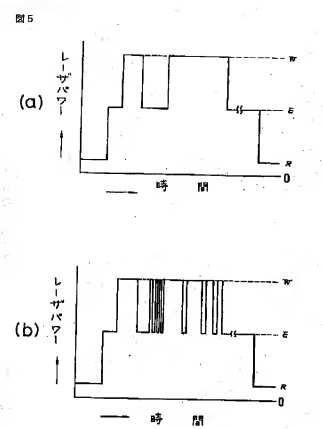


[Drawing 4]

図4



[Drawing 5]



[Translation done.]